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NON-CIRCULAR, FLAT MOTOR AND MANUFACTURING METHOD THEREOF

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a flat motor used as a silent alarming source in a mobile communications apparatus, and more particularly, to a non-circular, flat motor in which terminal portions are installed at dead space.

2. Description of the Related Art

Vibration motors using a centrifugal force of an eccentric body are now used as a silent alarming source in mobile communications apparatuses. Also, there is a flat coreless motor having a pinion gear at an output shaft which is used for transferring a pickup for detecting signals of a disc medium.

A conventional cylinder type vibration motor having a diameter of 4 mm is currently being widely used. However, since the vibration motor should be mounted by using a holder, the actual diameter thereof becomes 5 mm which does not keep pace with the ongoing trend to miniaturize portable apparatuses. Furthermore, the vibration motor is of a narrow cylinder type so that sufficient space in a radial direction for an eccentric weight installed at an output shaft cannot be secured, resulting in weak vibrations. In comparison, a flat motor having a thickness of 3 mm can be easily obtained. Also, large space in a radial direction can be obtained. The conventional flat vibration motor is shown in FIG. 12.

Referring to FIG. 12, a bracket **B** is formed of a magnetic body which is also used as a yoke. A thin disc magnet **D** is located on the bracket **B** and a shaft holder **Ba** is formed by raising a central portion of the bracket **B**. A shaft **S** is pressed into the shaft holder **Ba** and fixed thereto. An eccentric rotor **R** is rotatably installed at the shaft **S** to face the magnet **D** with an axial gap. The bracket **B** is covered by a thin case **K**.

A flat commutator **C** is formed of a printed circuit board and installed at the eccentric rotor **R**. A pair of brushes **Br** for providing electric power to the flat commutator **C** by slide-contacting the brushes **Br** are soldered to a thin flexible sheet **FS**. The flexible sheet **FS**, which extends outward between the magnet **D** and the bracket **B**, serves as a feeder terminal.

With a recent trend in a small and light mobile communication apparatus, electric parts mounted thereon becomes small and light and there is a need for parts that can be reflow soldered, a type of soldering used in the automation of an assembly process. However, in the case of an apparatus using an electric part having a magnet such as the flat motor, the magnet thermally deteriorates due to a high temperature during a process of reflow soldering. Also, it is difficult to hold the conventional motor which is circular when viewed in a plane with a transferring apparatus and the flexible sheet is very likely to be damaged when it is automatically mounted.

Also, in a method of installing the brushes **Br** at the thin flexible sheet **FS** by soldering, a displacement due to the spring force of the brushes **Br** when they slide-contact the flexible sheet **FS** needs to be prevented, so that the entire process becomes complicated. Also, the shaft itself becomes very small so that the manufacturing price of the shaft increases or the process of inserting the shaft is complicated.

SUMMARY OF THE INVENTION

To solve the above problems, it is an object of the present invention to provide a non-circular flat vibration motor which does not adopt a flexible sheet type feeder terminal, has a non-circular shape when viewed in a plane so as to be easily held by a transferring apparatus and automatically mounted, and has feeder terminals which are easily soldered, and a manufacturing method thereof.

Also, it is another object of the present invention to provide a non-circular flat vibration motor which uses a housing member instead of the shaft and can be simultaneously operated without a the flexible sheet and can be reflow soldered, and a manufacturing method thereof.

Also, it is yet another object of the present invention to provide a light, non-circular, flat vibration motor.

Accordingly, to achieve the above objects, there is provided a non-circular flat motor comprising a rotor, a housing formed to be non-circular when viewed in a plane which supports the rotor to be capable of rotating and simultaneously at least a part of side surfaces has a flat surface, and a plurality of feeder terminals arranged at an angled corner at the side surface of the housing which is formed by electrically

insulating at least one terminal of high electric potential from other portions adjacent thereto.

It is preferred in the present invention that the armature coil is arranged at a stator base functioning as part of the housing and simultaneously a magnet facing the armature coil is arranged at the rotor.

Also, it is preferred in the present invention that the housing is substantially rectangular and at least some of the feeder terminals are formed not to protrude outward over a corner of the rectangle as an angled portion for installation.

Also, it is preferred in the present invention that the motor further comprises a flat magnet, a bracket as part of the housing where the magnet is arranged, a brush incorporated with the feeder terminals via a gap between the bracket and the magnet, wherein the rotor receives electric power from the brush and simultaneously faces the flat magnet via a gap in an axial direction.

Also, it is preferred in the present invention that a base end portion of the brush is formed as part of the feeder terminal as it is.

Also, it is preferred in the present invention that the housing is substantially rectangular and at least some of the feeder terminals are formed not to protrude outward over a corner of the rectangle as an installation portion.

Also, to achieve the above objects, there is provided a non-circular flat motor comprising a rotor, a housing including a stator base having a shaft for supporting the rotor provided at the center thereof and having a non-circular shape, part of the housing being formed of resin, and at least two feeder terminals arranged at an angled corner at the side surface of the housing which is formed by electrically insulating at least one terminal of high electric potential from other portions adjacent thereto.

It is preferred in the present invention that the shaft is installed by erecting a shaft core from part of the housing constituting a stator and coating the shaft core with resin to form a resin coated, fixed shaft, and the rotor is rotatably installed from a tip of the resin coated, fixed shaft and the tip of the shaft is inserted in a concave portion installed at the other portion of the housing.

Also, it is preferred in the present invention that the motor further comprises a yoke plate formed of a magnetic body and having the shaft core integrally protruding from the center thereof, constituting part of the housing, a brushless recess portion

formed at the yoke plate to insulate the brush at least at one side, a resin bracket portion which includes a resin coated, fixed shaft made by incorporating in the resin bracket portion at least part of the yoke plate and coating the shaft core with resin, a rotor including a commutator and an armature coil having one end portion connected to the commutator and rotatably arranged at the resin coated, fixed shaft to face a magnet via a gap, a pair of brushes having a free end in sliding contact with the commutator and fixed such that at least two surfaces can expose base ends of the resin bracket portion through the brush recess portion, the magnet arranged at least at the yoke portion of the resin bracket portion after the brushes are arranged, and a case accommodating the rotor and installed at the resin bracket by inserting a tip of the resin coated, fixed shaft in a concave portion formed at the center of the case, at least a magnetic path portion of the magnet being formed of a magnetic body.

Also, it is preferred in the present invention that the magnet is separated from the yoke plate by a small gap to enable reflow soldering.

Also, it is preferred in the present invention that the yoke plate is separated from the case except for a combined portion.

Also, it is preferred in the present invention that a portion for reflow soldering is not close to the combined portion.

Also, it is preferred in the present invention that the resin of the resin coated, fixed shaft includes potassium titanate whisker and has an anti-thermal feature bearing a thermal deformation temperature of over 200°C (18.5 kgf/cm^2) and a slippery feature.

Also, to achieve the above objects, there is provided a non-circular flat brushless motor comprising a metal plate incorporating a shaft support portion at the center thereof, forming part of a housing, a fixed shaft supported by the shaft support portion, a rotor rotatably installed at the fixed shaft from a tip thereof, and a stator formed of a plurality of armature coils arranged around the fixed shaft to drive the rotor, in which the other part of the housing supports a tip of the fixed shaft.

It is preferred in the present invention that the fixed shaft has a shaft core cut from a metal plate and the shaft core is coated with resin.

Also, it is preferred in the present invention that a pinion is incorporated in the rotor.

Also, it is preferred in the present invention that the rotor is formed to be eccentric to generate vibrations during rotation.

Also, to achieve the above objects, there is provided a method of manufacturing a brush type non-circular flat motor comprising the steps of press-pressing a lead frame having a plurality of yoke plates continuously installed at a predetermined pitch by a connection portion, inserting the continuously installed yoke plates in an injection mold and integrally molding a resin bracket, detaching at least the connection portion of the yoke plates among the respective connection portions, installing the rotor at a fixed shaft to be capable of rotating, and installing the case.

It is preferred in the present invention that the method further comprises steps of fixing brushes to a resin bracket by a spot welding method, the brushes being formed by continuously installing via a plurality of connection portions at the same pitch as the predetermined pitch, and installing a magnet at the yoke plate.

BRIEF DESCRIPTION OF THE DRAWINGS

The above objects and advantages of the present invention will become more apparent by describing in detail preferred embodiments thereof with reference to the attached drawings in which:

FIG. 1 is a plan view showing a feature of a non-circular (square-shaped) flat motor of the present invention;

FIG. 2 is a sectional view of a brushless type non-circular flat vibration motor according to a preferred embodiment of the present invention, taken along line I-II of FIG. 1;

FIG. 3 is a cross sectional view of a coreless type non-circular flat vibration motor according to a second preferred embodiment of the present invention;

FIG. 4 is a view for explaining a method of manufacturing a part of the motor shown in FIG. 3;

FIG. 5A is a plan view showing a feature of a modified example of the non-circular flat motor of FIG. 1;

FIG. 5B is a side view of the motor of FIG. 5A viewing from the side indicated by arrow A;

FIG. 6A is a plane view showing a feature of another modified example of the non-circular flat motor of FIG. 1;

FIG. 6B is a side view of the motor of FIG. 6A viewing from the side indicated by arrow B;

FIG. 7 is a hidden detail view from above of a coreless type non-circular flat vibration motor according to a third preferred embodiment of the present invention;

FIG. 8 is a cross sectional view of the coreless type non-circular flat vibration motor of FIG. 7 taken along line III-IV;

FIG. 9 is a cross sectional view of a brushless type non-circular flat vibration motor according to a fourth preferred embodiment of the present invention;

FIG. 10 is cross sectional view of a brushless type non-circular flat geared motor according to a fifth preferred embodiment of the present invention;

FIG. 11 is a view for explaining a method of manufacturing parts of the motor of FIG. 7; and

FIG. 12 is a sectional view of the conventional flat vibration motor.

DETAILED DESCRIPTION OF THE INVENTION

In the below-described preferred embodiments, the same elements having the same functions are indicated by the same reference numerals and repeated descriptions thereof will be omitted.

FIG. 1 shows a feature of a square-shaped flat motor of the present invention. Referring to the drawing, a housing **H** has a built-in rotor and the top view thereof is square-shaped. Feeder terminals T1 and T2 or dummy or electricity feeding installation terminals T3 and T4 which are integrally formed by exposing part of a flexible sheet **FT** are arranged at the corner portions Ha. The corner portion Ha is formed to be concave such that each of the terminal, T1 - T4 does not protrude from the housing **H**. That is, the respective terminals T1 - T4 are located in the corner portions of the housing **H**.

Here, a non-circular shape may be any square shape such as a square, a rectangular, or a polygon, or may be a shape like a keyhole, when viewed in a plane. Also, in the present embodiment, each terminal is exposed outside by being folded so that reflow soldering can be easily performed.

The motor having the above shape can be applied to a variety of types such as a brushless type or a brush attached type. In this description, it is assumed that a brushless type motor consists of a rotor including a magnet and a housing including an armature motor, while a brush attached motor consists of a rotor including an armature coil and a housing including a magnet. That is, a rotating portion of a motor is called a rotor and the remaining portion other than the rotor is called a housing.

FIG. 2 shows a cross section of a square-shaped, axially gaped, brushless type flat motor, taken along line I-II of FIG. 1. That is, a shaft core 1a protrudes from the center of a metal stator baser 1 to which a printed circuit board is attached, and the shaft core 1a is coated with slippery resin to form a resin coated, fixed shaft 1S. A core holder 2 is integrally formed of the same resin to be slightly further out in the axial direction from the resin coated, fixed shaft 1S. A stator core 4 made by winding an armature coil 3 around a plurality of salient poles is welded to the core holder 2.

Since the rotor 5 is used as a vibration motor, a notch 5b is formed at a portion of a rotor case 5a. Also, a weight W formed of tungsten alloy is installed at the opposite position to the notch 5b at the outer surface of the rotor case 5a, forming eccentricity. A barring hole 5c which is further inwardly formed and a resin ring magnet 6 facing a plurality of blades 4a of the stator core 4 with a gap therebetween are installed at the rotor case 5a. The rotor case 5a is rotatably installed at the resin coated, fixed shaft 1S and excited by the stator core 4.

A leading end of the resin coated, fixed shaft 1S is supported by a concave portion 7a formed in a square cover 7 forming the housing H to provide reinforcement in a radial direction. Here, to constitute a brushless motor, a well known three-phase, sensor-less type structure is used and each of the above-described terminals function as both electrical connectors and mounts for the motor.

FIG. 3 shows a brush attached non-circular coreless flat vibration motor according to a second preferred embodiment of the present invention. A yoke 11a formed of a magnetic body is formed as a member of a bracket 11 which is a part of a housing. A shaft holder 11b proturdes from the center and a shaft J is fixed to the shaft holder 11b. The yoke 11a is cut from a first lead frame f1 formed of galvanized steel sheet having a thickness of 0.35 - 0.4 mm and integrally formed with a base

22 formed of liquid crystal, exhibiting an anti-solderability feature and having a square shape like the four terminals T1, T2, T3 and T4 including a dummy. The respective terminals T1 through T4 are cut from a second lead frame f2 formed of a thin plate which is corrosion resistant and easily soldered by a solder such as German silver. A thin disc magnet 66 having a thickness of about 0.8 mm is placed on the yoke 11a. Elastic brushes 8A and 8B coated with noble metal and having a thickness of about 0.05 mm are arranged in the inner radius area of the magnet 66. Base end portions 8Ac and 8Bc of the brushes 8A and 8B passing under a lower portion of the magnet 66 installed in the subsequent process are spot-welded to the terminals T1 and T2. The magnet 66 is installed at the bracket 11 via an acryl-based attaching member **A** having a thickness of about 0.15 mm from the surface of the brushes 8A and 8B for insulation of the brushes. Here, the brushes 8A and 8B are cut from a third lead frame f3 into a predetermined shape at the same pitch as those of the first and second lead frames f1 and f2. After the base 22 is formed, the brushes 8A and 8B are spot-welded to the terminals T1 and T2. Alternatively, the base end portions 8Aa and 8ba are extended outside and serve themselves as terminals.

In this case, the brush 8A is used as a feeder terminal for supplying a high electric potential and a recess groove 22a is installed at a neutral position of the magnet 66 to insulate the feeder terminal from other portion adjacent thereto. Also, for insulation of the bracket 11, a concave portion 22b for a recess is installed at a position where a connection portion 11c of the yoke 11a is cut. At least one of a plurality of magnet arrangement guides 22c protrudes to face the magnet and coated with resin.

To manufacture parts of the motor, for example, the stator base 22 of FIG. 3, as shown in FIG. 4, the first lead frame f1 of a galvanized steel sheet having a thickness of about 0.35 mm where the yoke portion is continuously formed at a necessary arrangement pitch and the second lead frame f2 of a German silver having a thickness of about 0.15 mm where the terminal portions are continuously formed corresponding to the above arrangement pitch, part of the second lead frame f2 being insulated, are continuously provided to a mold for integrally injection-molding the base 22 by taking, for example, 20 yoke portions, so that each is integrally formed of liquid crystal having an anti-solderability feature into a desired

shape. Then, the coil is installed and a predetermined task such as wiring is performed, the continuously installed portion is severed and the respective terminal portions having predetermined shapes are used.

FIG. 5A shows a modified example of the square-shaped flat motor of the present invention. While the motor in FIG. 1 has reflow type terminals, a terminal portion is formed to protrude in a latitudinal direction from the side surface in FIG. 5B so as to realize a contact type terminals. In this case, the terminal portion is formed to be compact such that it cannot protrude above an angled corner.

FIG. 6A shows another modified example of the square-shaped flat motor of the present invention which has an essentially octagonal shape. A terminal portion TT is bent to reduce its surface area, which facilitates reflow soldering as shown in FIG. 6B. This also helps to reduce the amount of heat that the terminal conducts into the motor. In this case, the terminal portion is formed to be compact so that it does not protrude above the angled corner.

Also, in this case, it does not matter that each terminal is transferred 180° reversely considering an installation pattern by making a sole terminal or diagonally positioned terminals have the same electric potential. This is of course so the above modifications can be applied to a brushless or brush attached motor. Although in the above preferred embodiments a vibration motor using an eccentric rotor is used as a vibration source, a pinion may be arranged at a rotor and a cylindrical rotation type motor such as a pickup transfer motor in an MD (mini disc), as described below, may be adopted.

FIG. 7 shows a coreless, non-circular, flat vibration motor according to a third preferred embodiment of the present invention. That is, a yoke plate 111 is formed of a magnetic body integrally formed with a shaft core 1a protruding from the center thereof, forming part of a housing. A pair of brush recess portions 1b and 1c are formed, one of these portions, which will be described later, is formed to be insulated from the yoke plate 111. In FIG. 8, the right brush recess portion 1b is a groove while the left brush recess portion 1c is a concave portion having a substantially the same thickness as that of the brush. The concave portion is slightly wider than the width of the thickness of an extended portion of the brush. The yoke plate 111 has a resin coated, fixed shaft 1S by coating the shaft core 1a with polyphenylene sulfide resin (product name: Otska Chemical Poticon) and is

integrally embedded by a resin bracket 222 except for a surface 1e where a magnet 66 is located and a connection portion 1f of a case 44 which will be described later. Here, a brush 8A, which is one of the pair of brushes arranged at the right brush recess portion 1b, is insulated from the yoke plate 111 by coating the brush 8A with resin 2a. The other brush 8B is directly arranged at the left brush recess portion 1c and grounded by contacting the yoke plate 111.

To manufacture the yoke plate 111 and the resin bracket 222, as shown in FIG. 11, a lead frame F1 having a plurality of the yoke plates 111 continuously installed at a predetermined pitch by a connection portion 1g, which are formed by press-processing galvanized steel sheet into a predetermined shape, is set on an injection mold (not shown) for manufacturing the bracket 222 formed of resin at the same pitch as shown in FIG. 8. Then, the set lead frame F1 and the resin bracket 222 are continuously and integrally molded.

Sliding contact portions 8Aa and 8Ba, extended portions 8Ab and 8Bb, and base end portions 8Ac and 8Bc of the brushes 8A and 8B are formed by press-processing a thin elastic German sheet. As shown in FIG. 7, a plurality of the brushes 8A and 8B are continuously installed at the same pitch as that of the yoke via a connection portion 8g at the end of each of the base end portions 8Ac and 8Bc. The extended portions 8Ab and 8Bb are accommodated in the brush recess portions 1b and 1c. The base end portion 8Ac at one side are welded to a portion of the resin bracket portion 222 while the base end portion 8Bc at the other side is welded to the yoke plate 111. Here, the base end portion 8Ac at one side is fixed such that a surface thereof is laterally exposed to facilitate soldering. The sliding contact portions 8Aa and 8Ba of the brushes 8A and 8B are formed to be arc shaped and sliding-contact a printed wiring commutator C arranged at a rotor 55.

The rotor 55 includes a resin guide portion 55a having high density (for example, a specific gravity of 3 through 8) which is integrally formed by making the printed wiring commutator C eccentric since the rotor itself generates vibrations of a centrifugal force and a plurality of eccentric armature coils 55b which are arranged to be eccentric toward one side by being attached to the resin guide portion 55a. The rotor 55 is rotatably installed at the resin coated, fixed shaft 1S via a bearing hole 55c installed at the center thereof to face the magnet 66 through a gap.

After the brushes 8A and 8B are arranged, the magnet 66 is attached to at least the yoke plate portion of the resin bracket portion by an acryl based double side adhesive member **A**. Thus, the magnet 66 is separated from the yoke plate 111 and insulation is achieved during reflow soldering.

After the rotor 55 is installed, to secure strength in a latitudinal direction, a leading end of the resin coated, fixed shaft 1S is inserted in a concave portion 44a formed at the center of a case 44 so as to be installed at the resin bracket 222 as a housing. The case 44 is welded to a connection portion 1f of the yoke plate 111 using laser as indicated by a dashed line in the drawing.

In FIG. 8, reference numeral 55d indicates a thrust washer for supporting the eccentric rotor 55 to be capable of sliding in response to an upward force applied by the brushes 8A and 8B.

FIG. 9 shows a brushless type non-circular flat motor according to a fourth preferred embodiment of the present invention. That is, a shaft core 1a proturdes from the center of a metal stator base (metal plate) 12 to which a printed circuit board is attached. The proturding shaft core 1a is coated with slippery resin, thus forming a resin coated, fixed shaft 1S.

A core holder 2 is integrally formed of the same resin to have a smalle radial separation from the resin coated, fixed shaft 1S. A stator core 4 formed by winding an armature coil 3 around a plurality of salient poles is welded to the core holder 2, thus forming a stator S3.

Here, since a rotor R3 is used as a vibration motor, a notch 48 is formed at a portion of a rotor case 45 to make the rotor R3 eccentric. A barring hole 49 having a smoothly processed inside is formed at the center of the rotor case 45. A ring type magnet 6 is installed at the rotor case 45 to face a plurality of blades 4a of the stator core 4 through a gap in a radial direction. The rotor case 45 is rotatably installed at the resin coated, fixed shaft 1S and is excited by a magnetic force from each of the blades 4a of the stator core 4. A tip of the resin coated, fixed shaft 1S is supported by a concave portion 8a arranged at a cover 8 for reinforcement in a radial direction.

FIG. 10 shows a non-circular flat motor according to a fifth preferred embodiment of the present invention which is used in a cylindrical rotary brushless motor such as a pickup transfer geared motor of an MD. The difference from the second preferred embodiment of FIG. 3 is that the rotor case 70 is not formed to be

unbalanced and a pinion 71 and a bearing portion 72 are integrally formed of anti-abrasion resin such as polyacetal on the upper surface of the rotor case 70.

Here, the tip of the resin coated, fixed shaft 1S is supported by a concave portion 88a arranged at a cover 88 for reinforcement in a radial direction. The cover 88 has a window 88b since a spur gear for transferring output of the pinion 71 is arranged as indicated by a dashed line.

FIG. 11 shows a method of manufacturing a part according to the preferred embodiment of FIG. 8. A bracket portion of a coreless brush attached motor can be easily manufactured in large numbers.

Also, in the manufacturing methods of the non-circular flat motor according to the above-described preferred embodiments, a plurality of yoke plates (metal plates) 1, 11, 12 and 111 which are cut from the lead frame F1 and form a part of the housing through the connection portion 1g, are continuously installed at a predetermined pitch. The connected yoke plates (metal plates) are inserted in an injection mold to integrally form resin brackets 2, 22 and 222. At lease the connection portion 1g of the yoke plates among the respective connection portions is cut. The rotors 5 and 55 are rotatably installed at the fixed shafts J and 1S. Then, the cases 4 and 44 are installed.

The manufacturing method of FIG. 11 further includes steps of fixing the brushes 8A and 8B formed by continuously installing a plurality of connection portions at the same pitch as the above pitch at the resin bracket 222 by spot welding, and arranging the magnet 66 at the yoke plate 111.

It is noted that the present invention is not limited to the preferred embodiment described above, and it is apparent that variations and modifications by those skilled in the art can be effected within the spirit and scope of the present invention defined in the appended claims.

As described above, according to the present invention, chucking is made easy without damaging the feeder terminal portion so that automatic mounting is possible. Also, since a dead space is used, there is no difference in substantial occupation compared to the conventional circular motor and a low profile coreless type motor is possible. Also, since the feeder terminal is made thin while maintaining a feature by making the yoke relatively thick, reflow soldering is made easy and an additional feeder terminal member is not necessary.

Further, the motor itself can be made light and an additional shaft is not necessary. When the motor is formed of resin integrally with the housing, a manufacturing cost may decrease and an effect of heat insulation can be obtained during reflow soldering. Also, a stainless bearing is not needed and a flat brushless motor with less sliding loss and bearing reflow soldering can be obtained. Also, mass production of coreless brush attached motors is possible by the manufacturing method of the present invention.